IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appellant: Gary R. Janik et al.

Assignee: KLA-Tencor Technologies Corporation

Title: LASER-BASED CLEANING DEVICE FOR FILM ANALYSIS TOOL

Serial No.: 10/056,271 File Date: January 23, 2002

Examiner: Gordon J. Stock, Jr. Art Unit: 2877

Docket No.: KLA-003

October 10, 2006

Mail Stop Appeal Brief-Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

APPEAL BRIEF

Sir:

This Appeal Brief is in support of the Notice of Appeal dated August 15, 2006.

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INDEX

I. REAL PARTY IN INTEREST

The real party in interest is the assignee, KLA-TENCOR CORPORATION, pursuant to the Assignment recorded in the U.S. Patent and Trademark Office on January 23, 2002 on Reel 012523, Frame 0686.

II. RELATED APPEALS AND INTERFERENCES

Based on information and belief, there are no other appeals or interferences that could directly affect or be directly affected by or have a bearing on the decision by the Board of Patent Appeals in the pending appeal.

III. STATUS OF CLAIMS

Claims 1, 8-21, 24, 27, 33-37, 41, 43, 44, 47, 51, and 52 are pending. Claims 1, 8-21, 24, 27, 33-37, 41, 43, 44, 47, 51, and 52 stand rejected.

In the present paper, rejected Claims 1, 8-21, 24, 27, 33-37, 41, 43, 44, 47, 51, and 52 are appealed.

Pending Claims 1, 8-21, 24, 27, 33-37, 41, 43, 44, 47, 51, and 52 are listed in Appendix A.

IV. STATUS OF AMENDMENTS

All claim amendments have been entered.

V. SUMMARY OF CLAIMED SUBJECT MATTER

A concise explanation of the subject matter defined in each of the independent claims (i.e. Claims 1, 27, 41, 51, and 52) involved in the appeal, referring to the Specification by page and line number (and paragraphs, for convenience), and to the drawing, if any, by reference characters follows.

Claim 1 **(Specification: page 7, lines 17-29, paragraph [0018]; page 11, line 22 to page 12, line 6; paragraph [0027])** A thin film analysis system **(Figs. 2a/2b: 200; Figs. 3a/3b: 300)** for analyzing a test sample **(Figs. 2a/2b: 210; Figs. 3a/3b: 310)**, the test sample **(Figs. 2a/2b: 210; Figs. 3a/3b: 310)** comprising a thin film **(Figs. 2a/2b: 212; Figs. 3a/3b: 312)** formed on a substrate **(Figs. 2a/2b: 211; Figs. 3a/3b: 311)** and a contaminant layer **(Figs. 2a/2b: 213; Figs. 3a/3b: 313)** formed on the thin film **(Figs. 2a/2b: 212; Figs. 3a/3b: 312)**, the thin film analysis system **(Figs. 2a/2b: 200; Figs. 3a/3b: 300)** comprising:

(Specification, page 8, lines 13-30, paragraphs [0020-0021]; page 12, line 21 to page 13, line 3, paragraphs [0029-0030]) an energy beam source **(Fig. 2a: 230; Fig. 3a: 330)** for directing an energy beam **(Fig. 2a: 231; Fig. 3a: 331)** at the contaminant layer **(Fig. 2a: 213; Fig. 3a: 313)** during a localized cleaning operation, the energy beam **(Fig. 2a: 231; Fig. 3a: 331)** being configured to heat only a small area **(Fig. 2a: 214a; Fig. 3a: 314a)** of the contaminant layer **(Fig. 2a: 213; Fig. 3a: 313)** until the small area **(Fig. 2a: 214a; Fig. 3a: 314a)** is vaporized, thereby creating an opening **(Fig. 2b: 214b; Fig. 2b: 314b)** in the contaminant layer **(Fig. 2b: 213; Fig. 3b: 313)**; and

(Specification, page 10, lines 11-30, paragraph [0024]; page 10, line 31 to page 11, line 10, paragraph [0025]; page 14, line 14 to page 15, line 8, paragraphs [0033-0034]) a thin film analysis module **(Figs. 2a/2b: 240; Figs. 3a/3b: 340)** for performing at least one of single wavelength ellipsometry (SWE), spectroscopic ellipsometry (SE), reflectometry, grazing incidence x-ray reflectometry (GXR), x-ray fluorescence (XRF), electron microprobe analysis (EMP), non-contact-based electrical analysis, and contact-based electrical analysis on the thin film **(Fig. 2b: 212; Fig. 3b: 313)** through the opening **(Fig. 2b: 214b; Fig. 3b: 314b)** in the contaminant layer **(Fig. 2b: 213; Fig. 3b: 313)**.

Claim 27 A method for analyzing a test sample **(Figs. 2a/2b: 210; Figs. 3a/3b: 310)**, wherein a contaminant layer **(Figs. 2a/2b: 213; Figs. 3a/3b: 313)** covers a thin film **(Figs. 2a/2b: 212; Figs. 3a/3b: 312)** of the test sample **(Figs. 2a/2b: 210; Figs. 3a/3b: 310)**, the method comprising:

(Specification, page 7, lines 21-22, paragraph [0018]; page 11, lines 28-30, paragraph [0027]) placing the test sample on a stage;

(Specification, page 8, lines 13-30, paragraphs [0020-0021]; page 12, line 21 to page 13, line 3, paragraphs [0029-0030]) during a localized cleaning operation, directing an energy beam at a first location on the contaminant layer while the test sample is on the stage, the energy beam heating only a small area of the contaminant layer until the small area is vaporized, thereby removing a first portion of the contaminant layer to create an opening in the contaminant layer to expose a first analysis area of the thin film; and

(Specification, page 10, lines 11-30, paragraph [0024]; page 10, line 31 to page 11, line 10, paragraph [0025]; page 14,

line 14 to page 15, line 8, paragraphs [0033-0034]) performing at least one of single wavelength ellipsometry (SWE), spectroscopic ellipsometry (SE), reflectometry, grazing incidence x-ray reflectometry (GXR), x-ray fluorescence (XRF), electron microprobe analysis (EMP), non-contact-based electrical analysis, and contact-based electrical analysis on the thin film at the first analysis area through the opening in the contaminant layer while the test sample is on the stage.

Claim 41 **(Specification: page 7, lines 17-29, paragraph [0018]; page 11, line 22 to page 12, line 6; paragraph [0027])** A thin film analysis system **(Figs. 2a/2b: 200; Figs. 3a/3b: 300)** for analyzing a test sample **(Figs. 2a/2b: 210; Figs. 3a/3b: 310)**, the test sample **(Figs. 2a/2b: 210; Figs. 3a/3b: 310)** comprising a thin film **(Figs. 2a/2b: 212; Figs. 3a/3b: 312)** formed on a substrate **(Figs. 2a/2b: 211; Figs. 3a/3b: 311)** and a contaminant layer **(Figs. 2a/2b: 213; Figs. 3a/3b: 313)** formed on the thin film **(Figs. 2a/2b: 212; Figs. 3a/3b: 312)**, the thin film analysis system **(Figs. 2a/2b: 200; Figs. 3a/3b: 300)** comprising:

(Specification, page 8, lines 13-30, paragraphs [0020-0021]; page 12, line 21 to page 13, line 3, paragraphs [0029-0030]) means **(Fig. 2a: 230; Fig. 3a: 330)** for directing an energy beam **(Fig. 2a: 231; Fig. 3a: 331)** at the contaminant layer **(Fig. 2a: 213; Fig. 3a: 313)** during a localized cleaning operation, the energy beam **(Fig. 2a: 231; Fig. 3a: 331)** heating only a small area **(Fig. 2a: 214a; Fig. 3a: 314a)** of the contaminant layer **(Fig. 2a: 213; Fig. 3a: 313)** until the small area **(Fig. 2a: 214a; Fig. 3a: 314a)** is vaporized, thereby removing a portion of the contaminant layer to create an opening **(Fig. 2b: 214b; Fig. 2b: 314b)** in the contaminant layer **(Fig.**

2b: 213; Fig. 3b: 313) to expose an analysis area **(Fig. 2b: 215; Fig. 2b: 315)** on the thin film **(Fig. 2b: 212; Fig. 2b: 312)**; and

(Specification, page 10, lines 11-30, paragraph [0024]; page 10, line 31 to page 11, line 10, paragraph [0025]; page 14, line 14 to page 15, line 8, paragraphs [0033-0034]) means **(Figs. 2a/2b: 240; Figs. 3a/3b: 340)** for performing at least one of single wavelength ellipsometry (SWE), spectroscopic ellipsometry (SE), reflectometry, grazing incidence x-ray reflectometry (GXR), x-ray fluorescence (XRF), electron microprobe analysis (EMP), non-contact-based electrical analysis, and contact-based electrical analysis on the thin film **(Fig. 2b: 212; Fig. 3b: 313)** at the analysis area **(Fig. 2b: 215; Fig. 3b: 315)** through the opening **(Fig. 2b: 214b; Fig. 3b: 314b)** in the contaminant layer **(Fig. 2b: 213; Fig. 3b: 313)**.

<u>Claim 51</u> **(Specification: page 7, lines 17-29, paragraph [0018]; page 11, line 22 to page 12, line 6; paragraph [0027])** A thin film analysis system **(Figs. 2a/2b: 200; Figs. 3a/3b: 300)** for analyzing a test sample **(Figs. 2a/2b: 210; Figs. 3a/3b: 310)**, the test sample **(Figs. 2a/2b: 210; Figs. 3a/3b: 310)** comprising a thin film **(Figs. 2a/2b: 212; Figs. 3a/3b: 312)** formed on a substrate **(Figs. 2a/2b: 211; Figs. 3a/3b: 311)** and a contaminant layer **(Figs. 2a/2b: 213; Figs. 3a/3b: 313)** formed on the thin film **(Figs. 2a/2b: 212; Figs. 3a/3b: 312)**, the thin film analysis system **(Figs. 2a/2b: 200; Figs. 3a/3b: 300)** comprising:

(Specification, page 8, lines 13-30, paragraphs [0020-0021]; page 12, line 21 to page 13, line 3, paragraphs [0029-0030]) an energy beam source **(Fig. 2a: 230; Fig. 3a: 330)** for directing an energy beam **(Fig. 2a: 231; Fig. 3a: 331)** at the contaminant layer **(Fig. 2a: 213; Fig. 3a: 313)** during a localized cleaning operation, the energy beam **(Fig. 2a: 231;**

Fig. 3a: 331) being configured to heat only a small area **(Fig. 2a: 214a; Fig. 3a: 314a)** of the contaminant layer **(Fig. 2a: 213; Fig. 3a: 313)** until the small area **(Fig. 2a: 214a; Fig. 3a: 314a)** is vaporized, thereby remove a portion of the contaminant layer **(Fig. 2a: 213; Fig. 3a: 313)** to expose an analysis area **(Fig. 2b: 215; Fig. 2b: 315)** on the thin film **(Fig. 2b: 212; Fig. 2b: 312)**; and

(Specification, page 10, lines 11-30, paragraph [0024]; page 10, line 31 to page 11, line 10, paragraph [0025]; page 14, line 14 to page 15, line 8, paragraphs [0033-0034]) means **(Figs. 2a/2b: 240; Figs. 3a/3b: 340)** a thin film analysis module **Figs. 2a/2b: 240; Figs. 3a/3b: 340)** for measuring the thin film **(Fig. 2b: 212; Fig. 3b: 313)** at the analysis area **(Fig. 2b: 215; Fig. 3b: 315)**, wherein the thin film analysis module **(Figs. 2a/2b: 200; Figs. 3a/3b: 300)** comprises a contact-based electrical analysis system **(Specification, page 14, lines 22-26, paragraph [0033])**.

Claim 52 A method for analyzing a test sample **(Figs. 2a/2b: 210; Figs. 3a/3b: 310)**, wherein a contaminant layer **(Figs. 2a/2b: 213; Figs. 3a/3b: 313)** covers a thin film **(Figs. 2a/2b: 212; Figs. 3a/3b: 312)** of the test sample **(Figs. 2a/2b: 210; Figs. 3a/3b: 310)**, the method comprising:

(Specification, page 7, lines 21-22, paragraph [0018]; page 11, lines 28-30, paragraph [0027]) placing the test sample on a stage;

(Specification, page 8, lines 13-30, paragraphs [0020-0021]; page 12, line 21 to page 13, line 3, paragraphs [0029-0030]) during a localized cleaning operation, directing an energy beam at a first location on the contaminant layer while the test sample is on the stage, the energy beam heating only a small area of the contaminant layer until the small area is

vaporized, thereby removing a first portion of the contaminant layer to expose a first analysis area of the thin film; and

(Specification, page 10, lines 11-30, paragraph [0024]; page 10, line 31 to page 11, line 10, paragraph [0025]; page 14, line 14 to page 15, line 8, paragraphs [0033-0034]) measuring the thin film at the first analysis area while the test sample is on the stage, wherein measuring the thin film comprises performing a contact-based electrical analysis.

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

The following issues are presented to the Board of Appeals for decision:

A. Whether Claims 1, 8, 14, 17-21, and 24 are patentable under 35 USC 103(a) over US Patent 5669979 (Elliot).

B. Whether Claims 9-13 and 15 are patentable under 35 USC 103(a) over Elliot in view of US Patent 6472295 (Morris).

C. Whether Claim 16 is patentable under 35 USC 103(a) over Elliot in view of US Patent 6333485 (Haight).

D. Whether Claims 27, 33, 35-37, 41, 44, and 47 are patentable under 35 USC 103(a) over Elliot in view of US Patent 4876983 (Fukuda).

E. Whether Claims 34 and 43 are patentable under 35 USC 103(a) over Elliot in view of Fukuda and Morris.

F. Whether Claim 51 is patentable under 35 USC 102(e) over US Patent 6355494 (Livengood).

G. Whether Claim 52 is patentable under 35 USC 103(a) over Livengood.

VII. ARGUMENTS

A. Claims 1, 8, 14, 17-21, and 24 are patentable under 35 USC 103(a) over US Patent 5669979 (Elliot)

1. Elliot: Overview

Elliot teaches various techniques for surface cleaning of semiconductor components. Col. 1, lines 13-17, 26-31, 36-40. In general, Elliot provides a directed flow of a fluid, including a reactant, in the vicinity of the foreign material, and delivers a beam of radiation to aid the reactant to react with the foreign material to form the reaction product(s). Col. 1, lines 44-50. In one embodiment, the beam of radiation is scanned across the surface, wherein less than all the processing of the semiconductor component is done in any one scan. Col. 3, lines 18-20.

2. Limitations recited in Claims 1, 8, 14, 17-21, and 24 are not taught by Elliot

Claim 1 recites:

> an energy beam source for directing an energy beam at the contaminant layer during a localized cleaning operation, the energy beam being configured to heat only a small area of the contaminant layer until the small area is vaporized, thereby creating an opening in the contaminant layer; and
>
> a thin film analysis module for performing at least one of single wavelength ellipsometry (SWE), spectroscopic ellipsometry (SE), reflectometry, grazing incidence x-ray reflectometry (GXR), x-ray fluorescence (XRF), electron microprobe analysis (EMP), non-contact-based electrical analysis, and contact-based electrical analysis on the thin film through the opening in the contaminant layer.

Appellant respectfully submits that Elliott fails to teach how the energy beam source creates the opening in the

contaminant layer as well as performing the analysis on the thin film. Specifically, Elliott teaches a technique in which "the entire surface of the substrate [is] passed beneath the illumination zone 468". Col. 22, lines 26-27. For this reason, Elliott frequently describes his technique as "surface cleaning". See, for example, col. 4, lines 14-15, 24-25; col. 6, lines 55-56; and col. 27, lines 22-23. Because Elliott teaches a bulk (total wafer) cleaning methodology, Elliott fails to teach a localized cleaning operation.

Moreover, Elliott teaches that to clean the surface of a substrate, a flow of a fluid including a reactant is directed at the contaminant layer. Col. 1, lines 44-47. To aid the reactant to react with the contaminant layer, a beam of radiation is delivered. Col. 1, lines 47-50. As explained by Elliott, laser beam pulses and an input gas cooperate to cause a phot-activated reaction between the input gas and the foreign material, thereby producing reaction products that can be removed from the reaction chamber. Col. 22, lines 15-19. Elliott also teaches that using this technique, laser pulses can remove photoresist in several passes. Col. 13, lines 62-65. Elliott postulates that this multiple pass technique is more efficient than a single pass removal (i.e. the reactive species in the input gas do not become depleted at higher scan speeds) because a smaller cloud of ablation components is formed, which can be easily reacted with and removed by the applied flow of input gas. Col. 14, lines 8-12. However, notably, the intent of Elliott in using a multiple pass technique is still to clean the entire surface of the substrate. See, e.g. col. 14, lines 49-56. In contrast, Appellant's invention uses the energy beam to heat only a small area of the contaminant layer until that small area is vaporized. This small area facilitates the

recited thin film analysis. Elliott fails to teach this recited use of the energy beam source.

Appellant respectfully submits that Elliott also fails to teach the thin film analysis module. Verifying that a surface has been cleaned (e.g. col. 21, lines 31-33) has nothing to do with the analysis of the thin film that can be advantageously accessed via the hole created by the energy beam.

Because Elliott fails to disclose or suggest multiple elements of Claim 1, Appellant requests reconsideration and withdrawal of the rejection of Claim 1.

Claims 8, 14, 17-21, and 24 depend from Claim 1 and therefore are patentable for at least the reasons presented for Claim 1. Based on those reasons, Appellant requests reconsideration and withdrawal of the rejection of Claims 8, 14, 17, 18-21, and 24.

B. Claims 9-13 and 15 are patentable under 35 USC 103(a) over Elliot in view of US Patent 6472295 (Morris)

1. Elliot: Overview (see Section A1)

2. Morris: Overview

Morris teaches employing laser light to generate high precision through-cuts in a target material. Col. 1, lines 6-8.

3. Limitations recited in Claims 9-13 and 15 are not taught by Elliot and Morris

Claims 9-13 and 15 depend from Claim 1 and therefore are patentable for at least the reasons presented for Claim 1. Morris fails to remedy the deficiency of Elliott with respect to Claim 1. Specifically, Morris teaches a laser light that can generate high precision through-cuts in a target material. Col.

1, lines 7-8. Thus, Morris also fails to teach how an energy beam source can create the opening in the contaminant layer as well as performing the analysis on the underlying thin film. Based on those reasons, Appellant requests reconsideration and withdrawal of the rejection of Claims 9-13 and 15.

C. Claim 16 is patentable under 35 USC 103(a) over Elliot in view of US Patent 6333485 (Haight)

1. Elliot: Overview (see Section A1)

2. Haight: Overview

Haight teaches using a pulsed laser beam to induce breakdown in a material. Col. 1, lines 56-57. Specifically, Haight generates a beam of laser pulses in which each pulse has a pulse width equal to or less than the predetermined laser pulse width value. Col. 1, lines 62-65. The beam is focused to appoint above the surface of the material where laser induced breakdown is desired. Col. 1, lines 65-67.

3. Limitations recited in Claim 16 are not taught by Haight

Claim 16 depends from Claim 1 and therefore is patentable for at least the reasons presented for Claim 1. Haight fails to remedy the deficiency of Elliott with respect to Claim 1. Specifically, Haight teaches focusing a laser beam above the surface of the material to be ablated. Col. 4, lines 36-43. Thus, Haight also fails to teach a thin film analysis module for performing an analysis on an underlying thin film. Based on those reasons, Appellant requests reconsideration and withdrawal of the rejection of Claim 16.

D. Claims 27, 33, 35-37, 41, 44, and 47 are patentable under 35 USC 103(a) over Elliot in view of US Patent 4876983 (Fukuda)

1. Elliot: Overview (see Section A1)

2. Fukada: Overview

Fukada teaches a plasma operation apparatus for performing thin film deposition on a substrate surface or etching, sputtering, or plasma oxidation for the substrate surface by utilizing plasma generated by microwave discharge. Col. 1, lines 5-10.

3. Limitations recited in Claims 27, 33, 35-37, 41, 44, and 47 are not taught by Elliot and Fukada

Claim 27 recites:

> during a localized cleaning operation, directing an energy beam at a first location on the contaminant layer while the test sample is on the stage, the energy beam heating only a small area of the contaminant layer until the small area is vaporized, thereby removing a first portion of the contaminant layer to create an opening in the contaminant layer to expose a first analysis area of the thin film; and
>
> performing at least one of single wavelength ellipsometry (SWE), spectroscopic ellipsometry (SE), reflectometry, grazing incidence x-ray reflectometry (GXR), x-ray fluorescence (XRF), electron microprobe analysis (EMP), non-contact-based electrical analysis, and contact-based electrical analysis on the thin film at the first analysis area through the opening in the contaminant layer while the test sample is on the stage.

Appellant respectfully submits that Elliott fails to teach how the energy beam source creates the opening in the contaminant layer as well as performing the analysis on the thin film. Specifically, Elliott teaches a technique in which "the entire surface of the substrate [is] passed beneath the illumination zone 468". Col. 22, lines 26-27. For this reason,

Elliott frequently describes his technique as "surface cleaning". See, for example, col. 4, lines 14-15, 24-25; col. 6, lines 55-56; and col. 27, lines 22-23. Because Elliott teaches a bulk (total wafer) cleaning methodology, Elliott fails to teach localized cleaning.

Moreover, Elliott teaches that to clean the surface of a substrate, a flow of a fluid including a reactant is directed at the contaminant layer. Col. 1, lines 44-47. To aid the reactant to react with the contaminant layer, a beam of radiation is delivered. Col. 1, lines 47-50. As explained by Elliott, laser beam pulses and an input gas cooperate to cause a phot-activated reaction between the input gas and the foreign material, thereby producing reaction products that can be removed from the reaction chamber. Col. 22, lines 15-19. Elliott also teaches that using this technique, laser pulses can remove photoresist in several passes. Col. 13, lines 62-65. Elliott postulates that this multiple pass technique is more efficient than a single pass removal (i.e. the reactive species in the input gas do not become depleted at higher scan speeds) because a smaller cloud of ablation components is formed, which can be easily reacted with and removed by the applied flow of input gas. Col. 14, lines 8-12. However, notably, the intent of Elliott in using a multiple pass technique is still to clean the entire surface of the substrate. See, e.g. col. 14, lines 49-56. In contrast, Appellant's invention uses the energy beam to heat only a small area of the contaminant layer until that area is vaporized. This small area facilitates the recited thin film analysis. Elliott fails to teach this recited use of the energy beam source.

Appellant respectfully submits that Elliott fails to teach the thin film analysis module. Verifying that a surface has been cleaned (e.g. col. 21, lines 31-33) has nothing to do with

the analysis of the thin film that can be accessed via the small hole created by the energy beam source.

Appellant submits that Fukuda fails to remedy the above-noted deficiencies of Elliot. Specifically, Fukuda teaches a plasma operation apparatus suitable for performing thin film deposition. Col. 1, lines 5-10. Thus, Fukuda also fails to teach how an energy beam source can create an opening in a contaminant layer as well as performing an analysis on an underlying thin film.

Because both Elliott and Fukuda fail to disclose or suggest multiple limitations of Claim 27, Appellant requests reconsideration and withdrawal of the rejection of Claim 27.

Claims 33 and 35-37 depend from Claim 27 and therefore are patentable for at least the reasons presented for Claim 27. Based on those reasons, Appellant requests reconsideration and withdrawal of the rejection of Claims 33 and 35-37.

Claim 41 recites:

> means for directing an energy beam at the contaminant layer during a localized cleaning operation, the energy beam heating only a small area of the contaminant layer until the small area is vaporized, thereby removing a portion of the contaminant layer to create an opening in the contaminant layer to expose an analysis area on the thin film; and
>
> means for performing at least one of single wavelength ellipsometry (SWE), spectroscopic ellipsometry (SE), reflectometry, grazing incidence x-ray reflectometry (GXR), x-ray fluorescence (XRF), electron microprobe analysis (EMP), non-contact-based electrical analysis, and contact-based electrical analysis on the thin film at the analysis area through the opening in the contaminant layer.

Therefore, Claim 41 is patentable for substantially the same reasons presented for Claims 1 and 27. Based on those

reasons, Appellant requests reconsideration and withdrawal of the rejection of Claim 41.

Claims 44 and 47 depend from Claim 41 and therefore are patentable for at least the reasons presented for Claim 41. Based on those reasons, Appellant requests reconsideration and withdrawal of the rejection of Claims 44 and 47.

E. Claims 34 and 43 are patentable under 35 USC 103(a) over Elliot in view of Fukuda and Morris

1. Elliot: Overview (see Section A1)

2. Fukada: Overview (see Section D2)

3. Morris: Overview (see Section B2)

4. Limitations recited in Claims 34 and 43 are not taught by Elliot, Fukada, and Morris

Claim 34 depends from Claim 27 and therefore is patentable for at least the reasons presented for Claim 27. Morris fails to remedy the deficiency of Elliot and Fukuda with respect to Claim 27. Specifically, Morris merely teaches that a laser light can generate high precision through-cuts in a target material. Col. 1, lines 7-8. Therefore, Appellant requests reconsideration and withdrawal of the rejection of Claim 34.

Claim 43 depends from Claim 41 and therefore is patentable for at least the reasons presented for Claim 41. Morris fails to remedy the deficiency of Elliot and Fukuda with respect to Claim 41. Specifically, Morris merely teaches that a laser light can generate high precision through-cuts in a target material. Col. 1, lines 7-8. Therefore, Appellant requests reconsideration and withdrawal of the rejection of Claim 43.

F. Claim 51 is patentable under 35 USC 102(e) over US Patent 6355494 (Livengood)

1. Livengood: Overview

Livengood teaches a method and apparatus for controlling the removal of material from an IC. Col. 1, lines 8-10. In this method, one side of a semiconductor substrate is illuminated, material from one or both side of the substrate is removed while monitoring a photo current amplitude through a P-N junction formed in the substrate, and removal of the material is discontinued in response to a predetermined change in the photo current amplitude. Col. 8, lines 41-47.

2. Limitations recited in Claim 51 are not taught by Livengood

Claim 51 recites:

> an energy beam source for directing an energy beam at the contaminant layer during a localized cleaning operation, the energy beam being configured to heat only a small area of the contaminant layer until the small are is vaporized, thereby remove a portion of the contaminant layer to expose an analysis area on the thin film; and
>
> a thin film analysis module for measuring the thin film at the analysis area, wherein the thin film analysis module comprises a contact-based electrical analysis system.

Livengood teaches the selective removal of at least a portion of material in order to make electrical contact to underlying components or to an underlying doped semiconductor region. Col. 1, lines 17-23. Therefore, Livengood fails to teach anything about a localized cleaning operation of a contaminant layer.

Notably, Livengood also teaches nothing about a thin film analysis module. FIG. 3, which is cited by the Examiner, shows

a graph of the photocurrent or induced current amplitude versus thickness of a semiconductor substrate material being etched/milled. Col. 4, lines 37-44. Thus, Livengood teaches when to stop etching/milling the substrate material, but teaches nothing about the analysis of an underlying thin film.

Because Livengood fails to disclose or suggest multiple limitations of Claim 51, Appellant requests reconsideration and withdrawal of the rejection of Claim 51.

G. Claim 52 is patentable under 35 USC 103(a) over Livengood

1. Livengood: Overview (see Section F1)

2. Limitations recited in Claim 52 are not taught by Livengood

Claim 52 recites:

> during a localized cleaning operation, directing an energy beam at a first location on the contaminant layer while the test sample is on the stage, the energy beam heating only a small area of the contaminant layer until the small area is vaporized, thereby removing a first portion of the contaminant layer to expose a first analysis area of the thin film; and
>
> measuring the thin film at the first analysis area while the test sample is on the stage, wherein measuring the thin film comprises performing a contact-based electrical analysis.

Therefore, Claim 52 is patentable for substantially the same reasons presented for Claim 51. Based on those reasons, Appellant requests reconsideration and withdrawal of the rejection of Claim 52.

H. CONCLUSION

For the foregoing reasons, it is submitted that the Examiner's rejections of Claims 1, 8-21, 24, 27, 33-37, 41, 43, 44, 47, 51, and 52 are erroneous, and reversal of these rejections is respectfully requested.

Respectfully submitted,

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VIII. CLAIMS APPENDIX

1 (Previously Presented) A thin film analysis system for analyzing a test sample, the test sample comprising a thin film formed on a substrate and a contaminant layer formed on the thin film, the thin film analysis system comprising:

an energy beam source for directing an energy beam at the contaminant layer during a localized cleaning operation, the energy beam being configured to heat only a small area of the contaminant layer until the small area is vaporized, thereby creating an opening in the contaminant layer; and

a thin film analysis module for performing at least one of single wavelength ellipsometry (SWE), spectroscopic ellipsometry (SE), reflectometry, grazing incidence x-ray reflectometry (GXR), x-ray fluorescence (XRF), electron microprobe analysis (EMP), non-contact-based electrical analysis, and contact-based electrical analysis on the thin film through the opening in the contaminant layer.

2-7. (Cancelled)

8. (Original) The thin film analysis system of Claim 1, wherein the energy beam source comprises a pulsed laser.

9. (Original) The thin film analysis system of Claim 8, wherein the pulsed laser comprises a Q-switched laser.

10. (Original) The thin film analysis system of Claim 9, wherein the Q-switched laser comprises a yttrium aluminum garnet (YAG) laser.

11. (Original): The thin film analysis system of Claim 10, wherein the YAG laser operates at a wavelength of approximately 532nm.

12. (Original) The thin film analysis system of Claim 10, wherein the YAG laser operates at a wavelength of approximately 355nm.

13. (Original) The thin film analysis system of Claim 8, wherein the pulsed laser comprises a pulsed diode laser.

14. (Original) The thin film analysis system of Claim 8, wherein the pulsed laser comprises an alexandrite laser.

15. (Original) The thin film analysis system of Claim 1, wherein the energy beam source comprises a continuous laser modulated to produce a pulse.

16. (Original) The thin film analysis system of Claim 1, wherein the energy beam source comprises a laser having a pulse energy between approximately 5 to 100 μJoules.

17. (Original) The thin film analysis system of Claim 1, wherein the energy beam source comprises an optical fiber for transmitting the laser beam from an energy beam generator to the portion of the contaminant layer.

18. (Original) The thin film analysis system of Claim 1, wherein the energy beam source comprises a flashlamp.

19. (Previously Presented) The thin film analysis system of Claim 1, wherein the opening in the contaminant layer exposes a non-functional region of the test sample.

20. (Previously Presented) The thin film analysis system of Claim 1, wherein the opening in the contaminant layer comprises a length and a width, wherein the length and the width are both approximately 20μm.

21. (Previously Presented) The thin film analysis system of Claim 1, wherein the thin film analysis module is configured to direct a probe beam at the test sample through the opening in the contaminant layer during the measurement operation, wherein the probe beam is focused on a first location on the test sample and the energy beam is focused on a second location on the test sample, the first location and the second location being substantially the same.

22-23. (Cancelled)

24. (Previously Presented) The thin film analysis system of Claim 1, wherein the thin film analysis module is configured to apply a probe structure to the thin film through the opening in the contaminant layer during the measurement operation, wherein the probe structure is aimed at a first location on the test sample and the energy beam is focused on a second location on the test sample, the first location and the second location being substantially the same.

25-26. (Cancelled)

27. (Previously Presented) A method for analyzing a test sample, wherein a contaminant layer covers a thin film of the test sample, the method comprising:

placing the test sample on a stage;

during a localized cleaning operation, directing an energy beam at a first location on the contaminant layer while the test sample is on the stage, the energy beam heating only a small area of the contaminant layer until the small area is vaporized, thereby removing a first portion of the contaminant layer to create an opening in the contaminant layer to expose a first analysis area of the thin film; and

performing at least one of single wavelength ellipsometry (SWE), spectroscopic ellipsometry (SE), reflectometry, grazing incidence x-ray reflectometry (GXR), x-ray fluorescence (XRF), electron microprobe analysis (EMP), non-contact-based electrical analysis, and contact-based electrical analysis on the thin film at the first analysis area through the opening in the contaminant layer while the test sample is on the stage.

28-32. (Cancelled)

33. (Original) The method of Claim 27, wherein directing the energy beam comprises applying at least one pulse from a pulsed laser to the first location on the contaminant layer.

34. (Original) The method of Claim 33, wherein the pulsed laser comprises a Q-switched yttrium aluminum garnet (YAG) laser.

35. (Original) The method of Claim 27, wherein the first analysis area comprises a non-functional region of the test sample.

36. (Previously Presented) The method of Claim 27, wherein the opening in the contaminant layer comprises a length and a width, wherein the length and the width are both approximately $20\mu m$.

37. (Previously Presented) The method of Claim 27, wherein the localized cleaning operation further comprises:

directing the energy beam at a second location on the contaminant layer, the energy beam heating only a second small area of the contaminant layer until the second small area is vaporized, thereby removing a second portion of the contaminant layer to create a second opening in the contaminant layer to expose a second analysis area of the thin film ; and

performing at least one of single wavelength ellipsometry (SWE), spectroscopic ellipsometry (SE), reflectometry, grazing incidence x-ray reflectometry (GXR), x-ray fluorescence (XRF), electron microprobe analysis (EMP), non-contact-based electrical analysis, and contact-based electrical analysis on the thin film at the second analysis area through the second opening in the contaminant layer.

38-40. (Cancelled)

41. (Previously Presented) A thin film analysis system for analyzing a test sample, the test sample comprising a thin film formed on a substrate and a contaminant layer formed on the thin film, the thin film analysis system comprising:

means for directing an energy beam at the contaminant layer during a localized cleaning operation, the energy beam heating only a small area of the contaminant layer until the small area is vaporized, thereby removing a portion of the contaminant

layer to create an opening in the contaminant layer to expose an analysis area on the thin film; and

means for performing at least one of single wavelength ellipsometry (SWE), spectroscopic ellipsometry (SE), reflectometry, grazing incidence x-ray reflectometry (GXR), x-ray fluorescence (XRF), electron microprobe analysis (EMP), non-contact-based electrical analysis, and contact-based electrical analysis on the thin film at the analysis area through the opening in the contaminant layer.

42. (Cancelled)

43. (Original) The thin film analysis system of Claim 41, wherein the means for directing the energy beam comprises a Q-switched yttrium aluminum garnet (YAG) laser.

44. (Original) The thin film analysis system of Claim 41, wherein the means for performing a measurement operation comprises means for directing a probe beam at the analysis area during the measurement operation, wherein the probe beam is focused on a first location on the test sample and the energy beam is focused on a second location on the test sample, the first location and the second location being substantially the same.

45-46. (Cancelled)

47. (Original) The thin film analysis system of Claim 41, wherein the means for performing a measurement operation comprises means for applying a probe structure to the analysis area during the measurement operation, wherein the probe structure is aimed at a first location on the test sample and

the energy beam is focused on a second location on the test sample, the first location and the second location being substantially the same.

48-50. (Cancelled)

51. (Previously Presented) A thin film analysis system for analyzing a test sample, the test sample comprising a thin film formed on a substrate and a contaminant layer formed on the thin film, the thin film analysis system comprising:

an energy beam source for directing an energy beam at the contaminant layer during a localized cleaning operation, the energy beam being configured to heat only a small area of the contaminant layer until the small are is vaporized, thereby remove a portion of the contaminant layer to expose an analysis area on the thin film; and

a thin film analysis module for measuring the thin film at the analysis area, wherein the thin film analysis module comprises a contact-based electrical analysis system.

52. (Previously Presented) A method for analyzing a test sample, wherein a contaminant layer covers a thin film of the test sample, the method comprising:

placing the test sample on a stage;

during a localized cleaning operation, directing an energy beam at a first location on the contaminant layer while the test sample is on the stage, the energy beam heating only a small area of the contaminant layer until the small area is vaporized, thereby removing a first portion of the contaminant layer to expose a first analysis area of the thin film; and

measuring the thin film at the first analysis area while the test sample is on the stage, wherein measuring the thin film comprises performing a contact-based electrical analysis.

IX. EVIDENCE APPENDIX

None

X. RELATED PROCEEDINGS APPENDIX

None